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10/523,636	02/04/2005	Nobuhiko Noto	136072	5874

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EXAMINER	
BOOKER, VICKI B	

ART UNIT	PAPER NUMBER
2813	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/523,636	NOTO ET AL.	
	Examiner	**Art Unit**	
	VICKI B. BOOKER	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 April 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1, 2, 4 – 7, 9 – 14, 17, 23, 25, 29, 31, 33, 34, 36, and 37* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 2, 4 – 7, 9 – 14, 17, 23, 25, 29, 31, 33, 34, 36, and 37* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *04 February 2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the correspondence filed April 24, 2008. Currently, **Claims 1**, **2**, **4 – 7**, **9 – 14**, **17**, **23**, **25**, **29**, **31**, **33**, **34**, **36**, and **37** are pending.

Information Disclosure Statement

As noted by Applicant, the information disclosure statement filed February 4, 2005 does not fail to comply with 37 CFR 1.98(a)(3) because a concise explanation of the relevance, as it is presently understood by the individual designated in 37 CFR 1.56(c) most knowledgeable about the content of the information, of each patent listed that is not in the English language, is included in the specification.

Therefore, Examiner has placed a new, signed information disclosure statement in the application file that notes that the foreign patent documents referred to therein have been considered.

Claim Rejections - 35 USC § 112

The amendment to the claims has been reviewed. Applicant's amendment of **Claim 1** overcomes the rejection under 35 U.S.C. 112, second paragraph.

Examiner withdraws the rejection under 35 U.S.C. 112, second paragraph.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, **2**, **4**, **6**, **7**, **12**, **14**, **23**, and **25** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh et al. (US 6,225,648 B1; dated 05/01/2001) in view of Toshihiro et al. (JP 1992-355541; published 07/08/1994) and further in view of Lakhani (J. Appl Phys., volume 56, page 1888; 15 September 1984). Examiner notes a machine translation of Toshihiro et al. has been made of record.

Regarding **Claim 1**, Hsieh et al. disclose a method of fabricating a light-emitting device having a light-emitting layer section configured as having a double heterostructure in which a first conductivity type cladding layer, an active layer, and a second conductivity type cladding layer, all of which being composed of $(Al_xGa_{1-x})_yIn_{1-y}P$ (where, $0 \leq x \leq 1$, $0 \leq y \leq 1$), are stacked in this order, and further comprising an ITO transparent electrode layer applying drive voltage for light-emission to the light-emitting layer section on at least either side of the first conductivity type cladding layer and the second conductivity type cladding layer (Abstract; Column 3, lines 14 – 46), comprising the steps of:

forming a GaAs layer 17 on the light-emitting layer section 14 (FIG. 2; Column 3, lines 35 - 37);

forming the ITO transparent electrode layer 19 so as to contact with the GaAs layer 17 to form a stack including the GaAs layer and the ITO transparent electrode layer (FIG. 2; Column 3, lines 43 – 46).

Hsieh et al. do not disclose

annealing the stack so as to allow In to diffuse from the ITO transparent electrode layer into the GaAs layer to thereby convert it into a contact layer composed of In-containing GaAs, wherein the annealing is carried out so as to adjust a mean In concentration of the contact layer within a range from 0.1 to 0.6 on the basis of atomic ratio of In to the total concentration of In and Ga, and wherein the annealing is carried out so as to adjust C_B/C_A to 0.8 or below, where C_A is In concentration at a boundary position between the contact layer and the ITO transparent electrode layer, and C_B is In concentration at a boundary position on the opposite side

Toshihiro et al. teach, in the same field of endeavor, annealing an ITO layer 24 such that the In diffuses from the ITO layer into a GaAs layer in direct contact with the ITO layer, in order to thereby form a contact layer composed of In-containing GaAs (FIG. 1; Paragraph [0007]). Toshihiro et al. teach that the annealing results in improving the ohmic contact by reducing the contact resistance between the ITO layer and the light-emitting layer section of the LED (Paragraphs [0002] - [0003]).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. by annealing the stack so as

to allow In to diffuse from the ITO transparent electrode layer into the GaAs layer to thereby convert it into a contact layer composed of In-containing GaAs, based on the teachings of Toshihiro et al.

The motivation for doing so, at the time of the invention, would have been to reduce the high contact resistance between the ITO layer and the light-emitting layer as taught by Toshihiro et al. (See above).

With regard to the further limitation of the annealing being carried out so as to adjust a mean In concentration of the contact layer within a range from 0.1 to 0.6 on the basis of atomic ratio of In to the total concentration of In and Ga, and wherein the annealing is carried out so as to adjust C_B/C_A to 0.8 or below, where C_A is In concentration at a boundary position between the contact layer and the ITO transparent electrode layer, and C_B is In concentration at a boundary position on the opposite side, Examiner notes the teachings of Lakhani.

Lakhani teaches, in the same field of endeavor (Abstract), that an ohmic contact layer to GaAs, formed by annealing of an In-containing layer, results in an improved contact resistance because of a growth of a graded indium concentration distribution in the thickness-wise direction of the contact layer (Page 1888, Column 1, lines 23 - 26; Page 1890, Column 2, lines 12 – 16).

Examiner notes that Lakhani thereby teaches that the indium concentration and its distribution ("graded indium concentration distribution") is a results-effective variable (MPEP § 2144.05). In other words, Lakhani teaches that the indium concentration and its distribution achieves a recognized result – an improved contact resistance.

Therefore, At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. such that the annealing is carried out so as to adjust a mean In concentration of the contact layer within a range from 0.1 to 0.6 on the basis of atomic ratio of In to the total concentration of In and Ga, and wherein the annealing is carried out so as to adjust C_B/C_A to 0.8 or below, where C_A is In concentration at a boundary position between the contact layer and the ITO transparent electrode layer, and C_B is In concentration at a boundary position on the opposite side, based on the teachings of Lakhani, since it has been held that, discovering an optimum condition of a results-effective variable involves only routine skill in the art. (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

A prima facie case of obviousness thereby exists for **Claim 1** (MPEP § 2142).

Regarding **Claim 2**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 1** as noted above, wherein the annealing is carried out at 600°C to 750°C, both ends inclusive (Toshihiro et al., Paragraph [0011]).

Regarding **Claim 4**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 2** as noted above, wherein process time of the annealing is set to 5 seconds to 120 seconds, both ends inclusive (Examiner notes Lakhani teaches that an ohmic contact layer to GaAs can be formed by annealing of an In-containing layer wherein process time of the annealing is set to 5 seconds to 120 seconds, both ends inclusive (See Lakhani, Page 1888, line 10; MPEP § 2144.05 Section I.) to achieve an improved contact resistance (See Lakhani, Page 1888,

Column 1, lines 23 - 26; Page 1890, Column 2, lines 12 – 16); A prima facie case of obviousness thereby exists for **Claim 4**; MPEP § 2142).

Regarding **Claim 23**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 2** as noted above, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive (Toshihiro et al. teach that the contact layer in the LED structure has a thickness as shown schematically and relative to other parts of the LED structure; See Paragraph [0007]; At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive, since it has been held that, where the general conditions of a claim are disclosed in the prior art, discovering optimum or workable ranges involves only routine skill in the art; In re Aller, 105 USPQ 233 (C.C.P.A. 1955); A prima facie case of obviousness thereby exists for **Claim 23**; MPEP § 2142).

Regarding **Claim 25**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 2** as noted above, wherein the annealing is carried out so as to make an In concentration distribution in the thickness-wise direction of the contact layer continuously reduce as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction (Examiner notes Lakhani teaches that an ohmic contact layer to GaAs, formed by annealing of an In-containing layer, results in an improved contact resistance because of a growth of a graded indium concentration distribution in the thickness-wise direction of the contact layer; See Page

1888, Column 1, lines 23 - 26; Page 1890, Column 2, lines 12 – 16; See also the discussion for **Claim 1** noting that Lakhani teaches the In concentration distribution is a results-effective variable; One of ordinary skill in the art, at the time of the invention, would use the teachings of Lakhani with Hsieh et al. in view of Toshihiro et al. such that annealing is carried out so as to make an In concentration distribution in the thickness-wise direction of the contact layer continuously reduce as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction, based on the teachings of Lakhani, since it has been held that, discovering an optimum condition of a results-effective variable involves only routine skill in the art. (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)); Furthermore, the motivation for doing so would have been to improve contact resistance as taught by Lakhani; A prima facie case of obviousness thereby exists for **Claim 25**; MPEP § 2142).

Regarding **Claim 6**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 1** as noted above, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive (Examiner notes Toshihiro et al. teach that the contact layer in the LED structure has a thickness as shown schematically and relative to other parts of the LED structure; See Paragraph [0007]; At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive, since it has been held that, where the general conditions of a claim are disclosed in the prior art, discovering optimum or

workable ranges involves only routine skill in the art; In re Aller, 105 USPQ 233 (C.C.P.A. 1955); A prima facie case of obviousness thereby exists for **Claim 6**; MPEP § 2142).

Regarding **Claim 7**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 1** as noted above, wherein the annealing is carried out so as to make an In concentration distribution in the thickness-wise direction of the contact layer continuously reduce as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction (Examiner notes Lakhani teaches that an ohmic contact layer to GaAs, formed by annealing of an In-containing layer, results in an improved contact resistance because of a growth of a graded indium concentration distribution in the thickness-wise direction of the contact layer; See Page 1888, Column 1, lines 23 - 26; Page 1890, Column 2, lines 12 – 16; See also the discussion for **Claim 1** noting that Lakhani teaches the In concentration distribution is a results-effective variable; One of ordinary skill in the art, at the time of the invention, would use the teachings of Lakhani with Hsieh et al. in view of Toshihiro et al. such that annealing is carried out so as to make an In concentration distribution in the thickness-wise direction of the contact layer continuously reduce as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction, based on the teachings of Lakhani, since it has been held that, discovering an optimum condition of a results-effective variable involves only routine skill in the art. (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)); Furthermore, the motivation for doing so would

have been to improve contact resistance as taught by Lakhani; A prima facie case of obviousness thereby exists for **Claim 7**; MPEP § 2142).

Regarding **Claim 12**, Hsieh et al. disclose a light-emitting device having a light-emitting layer section configured as having a double heterostructure in which a first conductivity type cladding layer, an active layer, and a second conductivity type cladding layer, all of which being composed of $(Al_xGa_{1-x})_yIn_{1-y}P$ (where, $0 \leq x \leq 1$, $0 \leq y \leq 1$), are stacked in this order; having an ITO transparent electrode layer 19 applying drive voltage for light-emission to the light-emitting layer section on at least either side of the first conductivity type cladding layer 140 and the second conductivity type cladding layer 144, so as to extract light from the light-emitting layer section 14 through the ITO transparent electrode layer 19 (FIG. 2; Column 3, lines 14 - 46).

Hsieh et al. do not teach or disclose having a contact layer composed of In-containing GaAs, formed between the light-emitting layer section and the ITO transparent electrode layer, as being in contact with the ITO transparent electrode layer, wherein the contact layer is designed to have an In concentration distribution in the thickness-wise direction thereof continuously reducing as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction.

Toshihiro et al. teach, in the same field of endeavor, annealing an ITO layer 24 such that the In diffuses from the ITO layer into a GaAs layer in direct contact with the ITO layer, in order to thereby form a contact layer composed of In-containing GaAs (FIG. 1; Paragraph [0007]). Toshihiro et al. teach that the annealing results in improving

the ohmic contact by reducing the contact resistance between the ITO layer and the light-emitting layer section of the LED (Paragraphs [0002] - [0003]).

Lakhani furthermore teaches that an ohmic contact layer to GaAs, formed by annealing of an In-containing layer, results in an improved contact resistance because of a growth of a graded indium concentration distribution in the thickness-wise direction of the contact layer (Page 1888, Column 1, lines 23 - 26; Page 1890, Column 2, lines 12 – 16). Examiner notes that Lakhani thereby teaches that the indium concentration is a result-effective variable that determines the contact resistance.

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. by having a contact layer composed of In-containing GaAs, formed between the light-emitting layer section and the ITO transparent electrode layer, as being in contact with the ITO transparent electrode layer, based on the teachings of Toshihiro et al. and Lakhani.

The motivation for doing so at the time of the invention would have been to reduce the contact resistance between the ITO layer and the light-emitting layer section of the LED as taught by Toshihiro et al. and Lakhani (See above discussion).

Furthermore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. based on the teachings of Toshihiro et al. and Lakhani such that the contact layer is designed to have an In concentration distribution in the thickness-wise direction thereof continuously reducing as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction, since it has been held that, discovering an optimum condition

of a result-effective variable involves only routine skill in the art. (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

Regarding **Claim 14**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 12** as noted above, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive (Toshihiro et al. teach that the contact layer in the LED structure has a thickness as shown schematically and relative to other parts of the LED structure; See Paragraph [0007]; At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive, since it has been held that, where the general conditions of a claim are disclosed in the prior art, discovering optimum or workable ranges involves only routine skill in the art; In re Aller, 105 USPQ 233 (C.C.P.A. 1955); A prima facie case of obviousness thereby exists for **Claim 14**; MPEP § 2142).

Claims 9, **10**, **11**, and **34**; **Claims 29**, **31**, **33**, and **36;** and **Claim 17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh et al. in view of Toshihiro et al. further in view of Lakhani as applied to **Claim 1**, **Claim 2**, and **Claim 12**, respectively as noted above, and further in view of Saeki (US 6,483,127 B2; dated 11/19/2002).

Regarding **Claim 9**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 1** as noted above.

Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani do not teach or disclose further comprising a step of forming, between the contact layer and either

cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer.

Saeki teaches, in the same field of endeavor (Abstract), inserting an intermediate layer 22 having an intermediate band gap energy between a contact layer 23 and a multi-film light reflecting layer 17 (FIG. 6). The purpose of this intermediate layer is to reduce device resistance by reducing discontinuity in the valence band in order to accelerate the transport of holes (Column 7, lines 42 - 48).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani by further comprising, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer, based on the teachings of Saeki.

The motivation for doing so at the time of the invention would have been to reduce device resistance by reducing discontinuity in the valence band in order to accelerate the transport of holes (Saeki, Column 7, lines 42 - 48).

Regarding **Claim 10**, Hsieh et al. in view of Toshihiro et al., further in view of Lakhani and still further in view of Saeki teach or disclose **Claim 9** as noted above,

wherein the intermediate layer is formed as containing at least any one of an AlGaAs layer, a GaInP layer and an AlGaInP layer (Saeki, Column 5, lines 52 – 54).

Regarding **Claim 11** and **Claim 34**, Hsieh et al. in view of Toshihiro et al., further in view of Lakhani, and still further in view of Saeki, teach or disclose **Claim 9** and **Claim 10** respectively as noted above, wherein the intermediate layer 22 and the contact layer 23 are formed over the entire surface of the light-emitting layer section 14, 15, 16 in this order, and the ITO transparent electrode layer 24 is formed so as to cover the entire surface of the contact layer 23 (Saeki, FIG. 6).

Regarding **Claim 29**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani (J. Appl Phys., volume 56, page 1888) teach or disclose **Claim 2** as noted above.

Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani do not teach or disclose further comprising a step of forming, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer.

Saeki teaches, in the same field of endeavor (Abstract), inserting an intermediate layer 22 having an intermediate band gap energy between a contact layer 23 and a multi-film light reflecting layer 17 (FIG. 6). The purpose of this intermediate layer is to reduce device resistance by reducing discontinuity in the valence band in order to accelerate the transport of holes (Column 7, lines 42 - 48).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani by further comprising, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer, based on the teachings of Saeki.

The motivation for doing so at the time of the invention would have been to reduce device resistance by reducing discontinuity in the valence band in order to accelerate the transport of holes (Saeki, Column 7, lines 42 - 48).

Regarding **Claim 31**, Hsieh et al. in view of Toshihiro et al., further in view of Lakhani, and still further in view of Saeki teach or disclose **Claim 29** as noted above, wherein the intermediate layer is formed as containing at least any one of an AlGaAs layer, a GaInP layer and an AlGaInP layer (Saeki, Column 5, lines 52 – 54).

Regarding **Claim 33** and **Claim 36**, Hsieh et al. in view of Toshihiro et al., further in view of Lakhani, and still further in view of Saeki teach or disclose **Claim 29** and **Claim 31**, respectively as noted above, wherein the intermediate layer 22 and the contact layer 23 are formed over the entire surface of the light-emitting layer section 14, 15, 16 in this order, and the ITO transparent electrode layer 24 is formed so as to cover the entire surface of the contact layer 23 (Saeki, FIG. 6).

Regarding **Claim 17**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 12** as noted above.

Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani do not teach or disclose further comprising, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer.

Saeki teaches, in the same field of endeavor (Abstract), inserting an intermediate layer 22 having an intermediate band gap energy between a contact layer 23 and a multi-film light reflecting layer 17 (FIG. 6). The purpose of this intermediate layer is to reduce device resistance by reducing discontinuity in the valence band in order to accelerate the transport of holes (Column 7, lines 42 - 48).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani by further comprising, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer, based on the teachings of Saeki.

The motivation for doing so at the time of the invention would have been to reduce device resistance by reducing discontinuity in the valence band in order to accelerate the transport of holes (Saeki, Column 7, lines 42 - 48).

Claim 5 and **Claims 13** and **37** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh et al. (US 6,225,648 B1; dated 05/01/2001) in view of Toshihiro et al. (JP 1992-355541; published 07/08/1994), further in view of Lakhani (J. Appl Phys., volume 56, page 1888; 15 September 1984), and still further in view of Bass et al. ("Handbook of Optics – Volume 1, Fundamentals, Techniques, and Design", pages 12.1 – 12.39, 1995).

Regarding **Claim 5** and **Claim 13**, Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani teach or disclose **Claim 1** and **Claim 12**, respectively as noted above.

Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani do not teach or disclose wherein the light-emitting layer section is configured using $(Al_xGa_{1-x})_yIn_{1-y}P$ (where, $0 \leq x \leq 1$, $0.45 \leq y \leq 0.55$) (**Claim 5**; **Claim 13**).

Bass et al. teach, in the same field of endeavor, that light-emitting devices come in a broad range of material systems, and that each material system requires a different optimization (Page 12.8, Section 12.5; Page 12.15, Section 12.6). Bass et al. teach that $(Al_xGa_{1-x})_yIn_{1-y}P$ is a known, suitable material for configuring a light-emitting layer section (See Page 12.19 to Page 12.21).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify Hsieh et al. in view of Toshihiro et al. and further in view of Lakhani such that the light-emitting layer section is configured using $(Al_xGa_{1-x})_yIn_{1-y}P$ (where, $0 \leq x \leq 1$, $0.45 \leq y \leq 0.55$), since it has been held that selection of suitable materials for an intended use is a matter of obvious design choice for one of ordinary skill in the art

when such suitability is known in the art. (*Sinclair & Carroll Co. v. Interchemical Corp.,* 325 U.S. 327, 65 USPQ 297 (1945); *In re* Leshin, 227 F.2d 197, 125 USPQ 416 (CCPA 1960); See also MPEP § 2144.07).

A prima facie case of obviousness thereby exists for **Claim 5** and **Claim 13** (MPEP § 2142).

Regarding **Claim 37**, Hsieh et al. in view of Toshihiro et al., further in view of Lakhani, and still further in view of Bass et al. teach or disclose **Claim 13** as noted above, wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive (Toshihiro et al. teach that the contact layer in the LED structure has a thickness as shown schematically and relative to other parts of the LED structure; See Paragraph [0007]; At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of Hsieh et al. in view of Toshihiro et al., further in view of Lakhani, and still further in view of Bass et al., wherein thickness of the contact layer is adjusted within a range from 0.001 μm to 0.02 μm, both ends inclusive, since it has been held that, where the general conditions of a claim are disclosed in the prior art, discovering optimum or workable ranges involves only routine skill in the art; In re Aller, 105 USPQ 233 (C.C.P.A. 1955); A prima facie case of obviousness thereby exists for **Claim 37**; MPEP § 2142).

Response to Arguments

Applicant's arguments with respect to **Claims 1**, **2**, **4 – 7**, **9 – 14**, **17**, **23**, **25**, **29**, **31**, **33**, **34**, **36**, and **37** have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vicki B. Booker whose telephone number is 571-270-1565. The examiner can normally be reached Monday through Thursday 9:30am to 6pm E.S.T. If attempts to reach the examiner by telephone are unsuccessful, the

examiner's supervisor, Zandra V. Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Vicki B. Booker/
Examiner, Art Unit 2813

/Zandra V. Smith/
Supervisory Patent Examiner, Art Unit 2822